



# RG<sup>®</sup> SERIES AIRCRAFT BATTERY OWNER/OPERATOR MANUAL

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## RECORD OF REVISIONS

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## SAFETY SUMMARY

- A. **WARNING: LOW CAPACITY HAZARD.** Aircraft batteries are certified to have a certain minimum capacity for emergency operations in the event of an electrical generator system failure. Never use a battery that has less than 80% of rated capacity and never “jump start” an aircraft that has a “dead” or discharged battery.
- B. **WARNING: ELECTRIC BURN HAZARD.** Lead-acid batteries are capable of delivering high currents if the terminals are shorted. The resulting heat can cause severe burns and is a potential fire hazard. Take the following precautions:
- Do not place tools or metal objects across battery terminals.
  - Do not wear conductive rings, belt buckles, watches or other jewelry when servicing batteries.
  - Wear insulated gloves and use insulated tools when servicing batteries.
  - Install battery terminal protectors whenever the battery is not connected in the aircraft or to the test equipment.
- C. **WARNING: DANGER OF EXPLODING BATTERIES.** Lead-acid batteries can produce explosive mixtures of hydrogen and oxygen while on charge or discharge, which can explode if ignited. Take the following precautions:
- Never install batteries in an airtight or sealed enclosure and make sure installation is adequately ventilated.
  - Do not smoke, use an open flame, or cause sparking near a battery.
  - Wear proper eye and face protection when servicing batteries.
  - Make sure work area is well ventilated.
  - Do not constant current charge a battery when installed in an aircraft.
  - Connect cables securely to the battery terminals to avoid arcing.
- D. **WARNING: DANGER OF CHEMICAL BURNS.** Lead-acid batteries contain sulfuric acid which can cause severe burns to body tissue. Take the following precautions:
- Never remove or damage vent valves.
  - Avoid contact of the electrolyte with skin, eyes or clothing.
  - Do not touch eyes after touching battery.
  - In the event of acid in the eyes, flush thoroughly with clean cool water for several minutes and get professional medical attention immediately.
  - Refer to battery MSDS for additional information.
- E. **CAUTION: DANGER OF EQUIPMENT DAMAGE.** To prevent damage to the connector, arc burns, or explosion, batteries should never be connected or disconnected while being charged or discharged. Batteries must be connected or disconnected only when the circuit is open. Ensure the aircraft battery switch, external power source, or the charger/analyzer is in the “OFF” position before connecting or disconnecting the battery. Battery terminal protectors should be installed whenever the battery is not connected in the aircraft or to the test equipment.

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## INTRODUCTION

A. **Thank you for choosing Concorde!** Your battery has been hand crafted to the highest quality control standards for superior reliability and durability. Our quality system is certified to AS9100 which is the highest standard for aviation products. Concorde aircraft batteries provide greater power for starting at cold temperatures, reliable emergency performance and longer life than any comparable product. Concorde has the most extensive selection of aircraft batteries available. Our batteries are installed as original equipment by over 50 different aircraft manufacturers and are used on military aircraft worldwide. Your satisfaction is guaranteed with a warranty that is honored internationally.

B. The purpose of this manual is to provide aircraft owners, operators and service centers with practical guidance for proper care of Concorde RG<sup>®</sup> Series valve-regulated lead acid aircraft batteries. This manual does not replace Concorde's FAA-approved Instructions for Continued Airworthiness (ICA)/Component Maintenance Manuals (CMMs). In the event of conflict between this manual and the applicable ICA/CMM, the ICA/CMM shall take precedence.

## BATTERY DESCRIPTION

A. Concorde RG<sup>®</sup> Series aircraft batteries are made using valve regulated lead acid cells. Each cell is sealed with a pressure relief valve that regulates the internal pressure and prevents gases from escaping. The positive and negative plates are sandwiched between layers of glass mat consisting of glass micro fibers of varying length and diameter. This blend features superior wicking characteristics and promotes maximum retention of the electrolyte. Electrolyte is absorbed and held in place by the capillary action between the fluid and the absorptive glass mat (AGM) fibers. By design, the AGM separator is only about 90-95% saturated with electrolyte. The void space provides the channels by which oxygen travels from the positive to the negative plates during charging. When the oxygen gas reaches the negative plate, it reacts with lead to form lead oxide and water. This reaction at the negative plate suppresses the generation of hydrogen that otherwise would come off the negative plate. In this manner, virtually all of the gas is recombined inside the cell, eliminating the need to add water, resulting in “maintenance free” operation.

B. The pressure relief valve (PRV) is designed to open when the internal pressure of a cell is approximately 1.5 psi above the external pressure. The PRV prevents excessive pressure buildup when the battery is being charged, and automatically reseals once the pressure is released. A slight bulge in the battery container can appear when the internal pressure increases slightly, but not enough to open the PRV. Alternatively, if the PRV opens at altitude and the battery is then returned to the ground, the external pressure can be greater than the internal pressure, resulting in a concave battery container. Both of these conditions are normal and do not affect the battery's operation.

**CAUTION: DO NOT REMOVE THE PRESSURE RELIEF VALVES ON AN RG BATTERY AND DO NOT ADD WATER OR ELECTROLYTE. THE RECOMBINANT GAS DESIGN ELIMINATES THE NEED TO REPLENISH WATER AND ELECTROLYTE. REMOVING THE PRESSURE RELIEF VALVE VOIDS THE WARRANTY.**

C. The RG<sup>®</sup> Series of aircraft batteries consist of 6 or 12 valve regulated lead acid cells connected in series to make a nominal 12 volt or 24 volt battery, respectively. The cells are contained in a plastic or metallic container equipped with an electrical receptacle for mating to the aircraft. In some models, externally mounted temperature sensors are present that interface to the aircraft charging and/or electrical system. Some models also include heaters to warm the battery for operation in extreme cold temperature environments.

D. Technical characteristics of the various battery models are detailed on Concorde's website (see front page of this manual). If internet access is not available, contact Concorde for assistance (see front page of this manual).

## STORAGE

- A. Batteries are serviced and charged at the factory prior to shipment.
- B. To prolong shelf life, batteries should be stored in a cool location, ideally below 20°C (68°F).
- C. The open circuit voltage (OCV) of a fully charged battery is approximately 26.0 volts (13.0 volts for 12 Volt batteries). As the battery state of charge drops due to self-discharge, its OCV also declines.
- D. Batteries should be boost charged when the OCV declines to 25.0 volts (12.5 volts for 12 Volt batteries).
- E. Batteries with an OCV below 25.0 volts (12.5 volts for 12 Volt batteries) due to improper or inadequate boost charging must be capacity tested before being placed in service.
- F. Refer to the applicable CMM for detailed instructions on boost charging and capacity testing.

## TRANSPORTATION

- A. The battery should be packaged in its original container. If the original container is not available, follow local packaging regulations applicable to the mode of transport.
  
- B. Concorde RG<sup>®</sup> Series batteries are exempt from DOT Hazardous Material Regulations, IATA Dangerous Goods Regulations, and IMDG Code. They can be shipped as non-hazardous by any means when properly packaged. For more details, refer to the battery Material Safety Data Sheet (MSDS) and the transportation information on Concorde's website (see front page of this manual).



## PREPARATION FOR INSTALLATION

- A. Remove battery from the shipping carton and visually inspect the battery for signs of damage. Do not use the battery if it appears to be damaged, contact Concorde for assistance.

**NOTE: Some battery models may have container sidewalls that are visibly bulged out or sucked in. These conditions are considered normal and will not affect the performance or life of the battery.**

- B. Measure the battery's open circuit voltage (OCV) with a calibrated digital multimeter (DMM).
- C. If the OCV equals or exceeds 25.5 volts (12.75 volts for 12 Volt batteries), the battery can be installed in the aircraft without charging.
- D. If the OCV equals or exceeds 25.0 volts (12.5 volts for 12 Volt batteries) and is less than 25.5 volts (12.75 volts for 12 Volt batteries), apply a boost charge before installation. The battery can then be installed in the aircraft.
- E. If the OCV is below 25.0 volts (12.5 volts for a 12 volt battery), perform a capacity test before installing in the aircraft.
- F. Refer to the applicable CMM for detailed instructions on boost charging and capacity testing.

## INSTALLATION

**NOTE: THE FOLLOWING INSTRUCTIONS ARE GENERIC. SEE AIRCRAFT MAINTENANCE MANUAL OR STC FOR INSTRUCTIONS SPECIFIC TO A PARTICULAR AIRCRAFT MODEL.**

**WARNING: LEAD ACID BATTERIES ARE HEAVY, WITH SOME MODELS EXCEEDING 50 POUNDS. USE APPROPRIATE LIFTING DEVICES OR EQUIPMENT. USE BATTERY HANDLES WHERE PROVIDED.**

**A. Remove Existing Battery (if present):**

1. Set Master Switch to the **OFF** position.
2. Disconnect any external power supply.
3. Open battery compartment access panel(s).
4. Disconnect battery quick disconnect plug or remove terminal bolts and disconnect battery cables from battery terminals. Always disconnect the ground cable first and install the ground cable last.
5. Disconnect battery ventilation tubes, if any.
6. Unlock battery hold down clamps or remove battery hold down bars.
7. Disengage battery and install terminal protection to prevent accidental shorting of terminals
8. Carefully remove from battery compartment.

**B. Install Replacement Battery**

1. Inspect the battery for damage. Cracks in metal or plastic containers are not permitted. Dents in metal containers that impinge on the interior plastic container are not acceptable. If defects are found, contact an authorized service center or contact Concorde for assistance.
2. Verify battery terminals are protected from shorting.
3. Set Master Switch to the **OFF** position.
4. Disconnect any external power supply.
5. Open battery compartment access panels.
6. Ensure the battery container or tray is clean and dry.
7. Install battery in battery container or tray.
8. Engage battery hold down hardware, torque and safety wire per aircraft maintenance manual.
9. Connect battery vent tubes to aircraft ventilation system, if present.
10. Remove battery terminal protection.
11. Connect battery quick disconnect plug and any auxiliary connectors.
12. For ring terminals, install with bolt and bevel lock washer provided with the battery. Torque terminal bolts as noted on the battery label. Always disconnect the ground cable first and install the ground cable last.

**CAUTION: ON BATTERIES WITH INTERNALLY THREADED TERMINALS, USE AN OPEN END WRENCH ON THE FLAT PORTION OF THE TERMINALS WHILE TORQUING THE TERMINAL BOLTS. FAILURE TO DO SO MAY RESULT IN THE RUPTURE OF THE BATTERY SEAL AT THE TERMINAL AND PREMATURE FAILURE OF THE BATTERY.**

**CAUTION: USE ONLY THE HARDWARE PROVIDED WITH THE BATTERY. DO NOT USE STAINLESS STEEL OR STEEL WASHERS BETWEEN THE RING TERMINAL AND THE BATTERY TERMINAL.**

13. Replace electrical compartment access panel.
14. Update aircraft weight and balance data, if necessary.
15. Perform an operational test.
16. Annotate battery log book with battery serial number, date of installation and aircraft hours (see Appendix B).

## OPERATION

A. Applications: Aircraft batteries are used to start engines and auxiliary power units (APUs), to provide emergency backup power for essential avionics equipment and lighting systems, to assure no-break power for navigation units and fly-by-wire computers, and to provide ground power capability for maintenance and preflight checkouts. Many of these functions are critical to safe operation of the aircraft, so the state of health of an aircraft battery is of utmost importance. Aircraft batteries are certified to have a certain minimum capacity for emergency operations in the event of an electrical generator system failure. If the battery is used to satisfy essential or emergency power requirements, its capacity must be tested periodically to assure airworthiness. See Servicing Section for capacity test instructions.

B. Battery Charging: The aircraft's electrical system automatically charges the battery when the engine(s) are running. Most aircraft allow charging using external power as well. The battery charging system in most aircraft is of the constant voltage type. With constant voltage charging, the battery will accept charging current inversely proportional to its state-of-charge (that is, the lower the state of charge, the higher the charging current). When the battery reaches full charge, the charging current tapers off to a very low value (typically 0.5% of the C1 capacity), and remains at that level to keep the battery on a "float charge". Therefore, an ammeter reading of the charging current (if present) is useful in determining the approximate state of charge of the battery.

C. Temperature Compensation: Battery service life can be prolonged by compensating the charging voltage based on the battery temperature. For aircraft that have an adjustable voltage regulator, the following table provides recommended settings:

Table 1. Recommended Voltage Regulator Settings

Battery Temperature	Voltage Regulator Setting (Volts DC)	
	12V System	24V System
Below 0°C (32°F)	14.5 – 14.75	29.0 – 29.5
0 to 15°C (32 to 59°F)	14.25 – 14.5	28.5 – 29.0
16 to 30°C (60 to 86°F)	14.0 – 14.25	28.0 – 28.5
31 to 45°C (87 to 113°F)	13.75 – 14.0	27.5 – 28.0
Above 45°C (113°F)	13.5 – 13.75	27.0 – 27.5

D. Ground Power Units: When aircraft are powered by ground power units, be sure that the DC output voltage is adjusted to the range shown in Table 1. Through the years there have been many reports of overcharged batteries due to ground power units being set too high. High charging voltages will shorten the battery service life significantly.

E. Open Circuit Voltage: The battery state of charge can be determined (approximately) from reading the battery's open circuit voltage (OCV). To get an accurate OCV, the battery needs to be stabilized on open circuit (no charging or discharging current) for at least 4 hours. Once the stabilized OCV is measured, the state of charge can be determined from the following table:

Table 2. State of Charge versus Open Circuit Voltage

Open Circuit Voltage		State of Charge (%)
12V Battery	24V Battery	
12.9 or above	25.8 or above	100%
12.6	25.2	75%
12.3	24.6	50%
12.0	24.0	25%
11.7 or below	23.4 or below	0%

**NOTE: THE BATTERY STATE OF CHARGE SHOULD NOT BE CONFUSED WITH STATE OF HEALTH (SEE GLOSSARY). A BATTERY AT 100% STATE OF CHARGE MAY OR MAY NOT HAVE GOOD STATE OF HEALTH (THAT IS, THE ACTUAL CAPACITY MAY OR MAY NOT BE CONSIDERED AIRWORTHY). THE ONLY RELIABLE METHOD TO DETERMINE BATTERY STATE OF HEALTH IS BY CAPACITY TEST (SEE SERVICING SECTION).**

F. Aircraft Storage: When an aircraft is placed in storage or remains dormant for an extended time, it is best to disconnect the battery connector. This practice will eliminate unnecessary drain on the battery if parasitic loads are present. Parasitic loads can deplete battery capacity and result in battery sulfation (see Paragraph G).

G. Sulfated Batteries: Lead-acid batteries become sulfated when they remain in a discharged state for extended periods of time. The longer the time period and the greater the depth of discharge, the worse the sulfation becomes. Sulfation may be reversible or irreversible, depending on the severity. Sulfation is evidenced by a low open circuit voltage (below 12.5V for a 12 volt battery or 25.0 volts for a 24 volt battery) after the battery has been subjected to a full recharge using normal (constant voltage) charging conditions. If the battery appears to be sulfated, it should be removed from the aircraft and subjected to a capacity test as detailed in the applicable CMM.

To prolong the battery service life, conditions leading to sulfation should be prevented as much as possible. For example, if the master switch is inadvertently left on and the battery becomes deeply discharged, it should be charged as soon as possible. Another cause of sulfation is a parasitic load that drains the battery capacity during extended dormant periods, as described in Paragraph F. Yet another cause of sulfation is repetitive short duration flights that do not give sufficient time for the battery to become fully charged. In this case, a periodic maintenance charge should be included to assure the battery becomes fully charged so as to minimize the buildup of sulfation.

#### H. Cold Weather Operation:

In cold climates, the state of charge of the battery should be kept at a maximum to prevent freezing of the electrolyte. A fully charged battery will not freeze even under the coldest weather conditions, but a discharged battery will freeze even when moderately cold. Table 3 gives the freezing point of electrolyte at various states of charge.

Frozen batteries are not capable of charging or discharging except at very low rates, and may be permanently damaged by expansion of the electrolyte. If a battery becomes frozen, it should be thawed by placing it at room temperature for at least 24 hours, and then serviced in accordance with the applicable CMM. However, if the battery container has any evidence of cracking, the battery is no longer serviceable and should not be used.

Operating an aircraft battery in cold weather is equivalent to using a battery of lower capacity. For example, a fully charged battery at 25°C (77°F) may be capable of starting an engine twenty times. At -18°C (0°F) the same battery may start the engine only three times. Low temperatures also increase the time necessary for charging a battery. A battery which could be recharged in an hour at 25°C (77°F) while flying may require 5 hours for charging when the temperature is -18°C (0°F).

**CAUTION: WHEN THE AMBIENT TEMPERATURE IS BELOW 0°C (32°F), THE ENGINE(S) SHOULD BE STARTED USING BATTERY POWER INSTEAD OF A GROUND POWER UNIT. THIS PROCEDURE WARMS THE BATTERY AND IMPROVES ITS CHARGE ACCEPTANCE. IF THE BATTERY IS NOT USED TO START THE ENGINE(S) IN COLD TEMPERATURES, THE BATTERY MAY NOT HAVE SUFFICIENT EMERGENCY POWER DURING FLIGHT.**

**NOTE: SOME RG® SERIES BATTERIES CONTAIN INTERNAL HEATERS THAT ARE POWERED BY THE AIRCRAFT ELECTRICAL SYSTEM. ONCE THE AIRCRAFT IS POWERED UP, THE HEATERS WARM THE BATTERY TO IMPROVE ITS CHARGE ACCEPTANCE IN COLD WEATHER. IF THE MAIN BATTERY CONTAINS A HEATER, IT IS NOT NECESSARY TO USE BATTERY POWER TO START THE ENGINE(S) IF GROUND POWER UNIT IS AVAILABLE.**

**In Summary:** During cold weather, keep batteries fully charged. Make every effort to conserve battery power. Consider using a heated battery to improve charge acceptance.

Table 3. Electrolyte Freezing Point versus Battery State of Charge

Battery State of Charge (%)	Approximate Electrolyte Freezing Temperature
100%	-70°C (-94°F)
75%	-47°C (-53°F)
50%	-25°C (-13°F)
25%	-13°C (9°F)
0%	-6°C (21°F)

I. Ventilation Systems: Airplanes are often equipped with a battery ventilation system. The ventilation system provides for removal of gasses and acid fumes from the battery via vent tubes on the battery case. Ventilation systems are usually a necessity when flooded type batteries are used, but the amount of gas and acid fume generation is minimal from Concorde RG<sup>®</sup> Series valve regulated batteries. In some installations, the venting system is eliminated as part of the aircraft modification when changing from a flooded battery to a valve-regulated battery. However, if the venting system is present, it should be connected when installing Concorde RG<sup>®</sup> Series batteries.

**CAUTION: NEVER INSTALL AN RG<sup>®</sup> SERIES BATTERY IN A SEALED OR AIRTIGHT ENCLOSURE. COMBUSTABLE GASSES ARE EMITTED DURING CHARGE AND MUST BE PERMITTED TO ESCAPE.**

J. Jump Starting: Never "jump" start an aircraft that has a "dead" battery. A "dead" battery, by definition, will not start an engine by itself and generally has an unknown state of charge and state of health. A "dead" battery may appear to charge normally but may require an extended charging time or a special charging method to return it to an airworthy condition. In the event of an alternator or generator failure, the battery may not be available to support the required emergency loads. To be on the safe side, always remove a "dead" battery from the aircraft and perform a capacity test to verify airworthiness.

## SERVICING

A. Charging Battery While Installed: Batteries may be charged while installed on the aircraft with the following restrictions:

- Battery charger meets the requirements specified in the CMM or it is specifically approved by Concorde.
- The battery compartment is well ventilated.

As an extra precaution, the battery should be disconnected from the aircraft electrical system if there is any possibility the charging source may put out excessive voltage that could damage equipment connected to the battery bus.

B. Scheduled Inspections: If the battery is used to satisfy essential or emergency power requirements, its capacity must be tested periodically to assure airworthiness. In general, a battery is considered airworthy if it has at least 80% of rated capacity. Concorde and the FAA recommend 85% as the pass/fail criteria to provide a margin of safety. The battery should be removed from the aircraft to perform a capacity test. Refer to the applicable CMM for detailed instructions regarding frequency of inspections and capacity test procedures.

C. Unscheduled Inspections: The battery should be subjected to a capacity test under any of the following conditions:

- Abnormally slow engine starting,
- Abnormally high charging current (greater than 5% of C1 capacity) after several hours of charging, or
- Battery becomes excessively hot (case temperature above 55°C/131°F).

D. Repairs: The cells and other internal components of most RG® Series batteries are non-repairable. The battery assembly must be replaced when internal components fail or wear out. If external repairs are needed to the battery assembly (i.e., missing labels, dents, scratches, etc.), send it to an authorized repair facility or contact Concorde for assistance.

**NOTE: SOME RG® SERIES BATTERIES HAVE REPLACEABLE SUBASSEMBLIES, AND THE CMM FOR THESE BATTERIES INCLUDE AN ILLUSTRATED PARTS LIST FOR THE REPLACEABLE COMPONENTS.**

E. Temperature Sensors: Some battery models are equipped with externally mounted temperature sensors. Instructions for inspection and testing of Concorde temperature sensors are contained in separate maintenance manual supplements for each type of temperature sensor. These maintenance manual supplements are available on Concorde's website (see front page of this manual). If internet access is not available, contact Concorde for assistance.

G. Servicing Parallel Batteries: In some aircraft, two identical batteries are used in parallel for starting engines. The recommended practice is to replace both batteries even if only one has low capacity. The replacement batteries should be of the same or similar age and usage history. When batteries of different age are used in parallel, the newer battery will work harder due to lower resistance, which accelerates aging of the newer battery.



## DISPOSAL

- A. Concorde RG<sup>®</sup> Series batteries contain lead, sulfuric acid, and other hazardous materials. Never discard batteries in the trash or in a landfill.
- B. The battery materials are 100% recyclable. Dispose spent batteries and assemblies in accordance with local ordinances and regulations.
- C. Some RG<sup>®</sup> Series batteries have outer shells made of aluminum, steel or titanium. These outer shells must be removed before the battery is sent to the smelter. Make sure the recycling collector is aware of this requirement.
- D. See battery Material Safety Data Sheet (MSDS) for additional information.

## APPENDIX A – GLOSSARY

**Active material** - Electrode material which produces electricity during its chemical conversion.

**AGM** - Absorbent glass mat used as a separator material between positive and negative plates. Electrolyte is absorbed and held in place by the capillary action between the fluid and glass mat fibers.

**Battery** - A combination of two or more chemical cells electrically connected together to produce electric energy. Common usage permits this designation to be applied also to a single cell used independently.

**Boost charge** - A charge applied to a battery which is already near a state of full charge. Usually a charge of short duration.

**C1 rate** - The one hour discharge or current rate in amperes that is numerically equal to rated capacity of a cell or battery in ampere hours. For example, the C1 rate of a battery rated at 42 Ah is 42 amperes.

**Capacity** - The quantity of electricity delivered by a battery under specified conditions, usually expressed in ampere hours.

**Cell** - An electrochemical device composed of positive and negative plates, separator and electrolyte which is capable of storing electrical energy.

**Charge** - The conversion of electrical energy from an external source into chemical energy within a cell or battery.

**Charge rate** - The rate at which current is applied to a battery to restore its capacity.

**Constant potential (CP) charge** - Charging method where the output voltage of the charge source is held constant and the current is limited only by the resistance of the battery or by the capability of the charging source.

**Constant current (CC) charge** - Charging method where the output current of the charge source is held constant and the voltage is not regulated.

**Current** - The rate of flow of electricity. The unit of measurement is an ampere.

**Deep discharge** - Withdrawal of 50% or more of the rated capacity of a battery.

**Depth of discharge** - The portion of the nominal capacity from a cell or battery taken out during each discharge cycle, expressed in a percentage.

**Discharge** - The conversion of the chemical energy of a battery into electrical energy and withdrawal of the electrical energy into a load.

**Discharge rate** - The rate of current flow from a battery during discharge.

**Electrolyte** - In a lead acid battery, the electrolyte is sulfuric acid diluted with water. It is a conductor and also a supplier of hydrogen and sulfate ions for the electrochemical reactions occurring at the plates.

**End of life** - The stage at which the battery or cell meets specific failure criteria.

**End Point Voltage (EPV)** - The voltage at which the discharge current is terminated when measuring battery capacity. Sometimes called cutoff voltage or voltage end point. Unless otherwise stated, the EPV is equal to 20.0 volts for 24 volt aircraft batteries (10.0 volts for 12 volt batteries).

**Float charge** - A method of maintaining a cell or battery in a charged condition by continuous, long term constant voltage charging at a level sufficient to balance self discharge.

**Gassing** - The evolution of gas from one or more of the electrodes in a cell when the battery reaches full charge.

**Internal impedance** - The electrical impedance inside the battery that restricts the flow of current during high rate charging and discharging. The internal impedance depends on the size of the battery, state of charge, temperature and age.

**Ipp/Ipr** – The Ipp is the peak power current, defined as the current which the battery delivers at 0.3 seconds during a constant voltage discharge equal to half of the nominal voltage. The Ipr is the power rating, defined as the current which the battery delivers at 15 seconds during a constant voltage discharge equal to half of the nominal voltage.

**Lead acid** - Term used in conjunction with a battery that utilizes lead and lead dioxide as the active plate materials in a diluted electrolyte solution of sulfuric acid and water. Nominal cell voltage is 2 volts.

**Lead dioxide** – The oxide of lead present in charge positive plates ( $\text{PbO}_2$ ) and is sometimes referred to as lead peroxide.

**Lead sulfate** - A lead salt formed by the action of sulfuric acid on lead oxide during paste mixing and formation. It is also formed electrochemically when a battery is discharged.

**Load tester** - An instrument which measures the battery voltage with an electrical load on the battery to determine its overall condition.

**Nominal voltage** – Approximate voltage of a fully charged cell or battery. For lead acid cells, the nominal voltage is 2 volts. The nominal voltage of a 6-cell battery is 12 volts and that of a 12-cell battery is 24 volts.

**Open circuit voltage (OCV)** - The voltage of the battery at rest (no charging or discharging current present). A stable OCV requires a rest of at least four hours.

**Overcharge** – Applying excessive voltage to force current through a cell after all the active material has been converted to the charged state. The result is decomposition of water in the electrolyte into hydrogen and oxygen gas and accelerated grid corrosion.

**Oxygen recombination** - The process by which oxygen generated at the positive plate during charge reacts with the pure lead material of the negative plate to reform water.

**Parallel connection** - A circuit in which battery terminals of like polarity are connected together. The capacity of each battery adds together while voltage remains the same.

**Rated C1 capacity** - The nominal capacity, expressed in Ampere-hours (Ah), obtained from a fully charged battery when discharged at the one hour rate to the specified end point voltage at a temperature of 21 - 25°C (70 - 77°F).

**Self discharge** - The decrease in the state of charge of a battery, over a period of time, due to internal electrochemical losses. The self-discharge rate accelerates as the temperature increases and as the battery ages.

**Separator** - A porous, insulating material placed between plates of opposite polarities to prevent internal short circuits.

**Series connection** - A circuit in which battery terminals of opposite polarity are connected together. The voltage of each battery adds together while capacity remains the same.

**Specific gravity (S.G.)** - The weight of the electrolyte as compared to the weight of an equal volume of pure water, used to measure the strength or percentage of sulfuric acid in the electrolyte.

**State of Charge (SOC)** - The ratio of available capacity in a battery to its fully charged capacity. Example: Battery A is discharged and gives 32 Ah of capacity to its EPV. After a full charge, it is discharged again and gives 40 Ah. The SOC of Battery A before the first discharge was  $32/40 = 80\%$ . Note that the SOC does not represent the battery's capacity as a percentage of its rated capacity and should not be used to determine airworthiness (See State of Health).

**State of Health (SOH)** - The ratio of available capacity in a battery when fully charged to its rated capacity. Example: Battery B is fully charged and gives 38 Ah capacity to its EPV. Battery B is rated at 42 Ah. The SOH of battery B is  $38/42 = 90\%$ . The SOH is measured when a capacity test is performed and is used to determine the battery's airworthiness.

**Sulfation** - Refers to the formation of lead sulfate within the battery plates when a battery is discharged. If the battery remains discharged, the lead sulfate becomes more resistive which can limit or prevent the recharging of the battery. Sulfated batteries may sometimes be recovered with a special conditioning charge.

**Valve regulated lead-acid (VRLA) battery** - A lead-acid battery in which there is no free electrolyte and the internal pressure is regulated by a pressure relief valve. This type of battery requires no maintenance of the liquid level and recombines the gases formed on charge within the battery to reform water. The battery may be used in any attitude without danger of leakage or spilling of electrolyte.

**Valve regulated sealed lead-acid (VRSLA) battery** – An alternate terminology for a VRLA battery (see definition above).

## APPENDIX B – BATTERY MAINTENANCE LOG

Concorde Battery P/N:	Battery S/N:		
Date of Initial Installation:	A/C Hours @ Date of Installation:		
	OCV @ Time of Installation: V		
Aircraft Make:	Model:	S/N:	
1 <sup>st</sup> Removal Date:	A/C Hours @ Date of Removal:		
Reason for Removal:	Capacity Check	%	Minutes
Date Reinstalled:	A/C Hours @ Date of Reinstallation:		
	OCV @ Time of Reinstallation: V		
Aircraft Make:	Model:	S/N:	
2 <sup>nd</sup> Removal Date:	A/C Hours @ Date of Removal:		
Reason for Removal:	Capacity Check	%	Minutes
Date Reinstalled:	A/C Hours @ Date of Reinstallation:		
	OCV @ Time of Reinstallation: V		
Aircraft Make:	Model:	S/N:	
3 <sup>rd</sup> Removal Date:	A/C Hours @ Date of Removal:		
Reason for Removal:	Capacity Check	%	Minutes
Date Reinstalled:	A/C Hours @ Date of Reinstallation:		
	OCV @ Time of Reinstallation: V		
Aircraft Make:	Model:	S/N:	
4 <sup>th</sup> Removal Date:	A/C Hours Date of Removal:		
Reason for Removal:	Capacity Check	%	Minutes
Date Reinstalled:	A/C Hours Date of Reinstallation:		
	OCV @ Time of Reinstallation: V		
Aircraft Make:	Model:	S/N:	
5 <sup>th</sup> Removal Date:	A/C Hours @ Date of Removal:		
Reason for Removal:	Capacity Check	%	Minutes
Date Reinstalled:	A/C Hours Date of Reinstallation:		
	OCV @ Time of Reinstallation: V		
Aircraft Make:	Model:	S/N:	
6 <sup>th</sup> Removal Date:	A/C Hours @ Date of Removal:		
Reason for Removal:	Capacity Check	%	Minutes
Notes:			
1. The open circuit voltage (OCV) should equal or exceed 25.5 volts for 24 Volt batteries (12.75 volts for 12 Volt batteries) at the time of installation into the aircraft.			
2. Refer to Concorde Battery Instructions for Continued Airworthiness/Component Maintenance Manual for installation, inspection and charging instructions.			
3. A copy of this maintenance log should be submitted for warranty consideration.			